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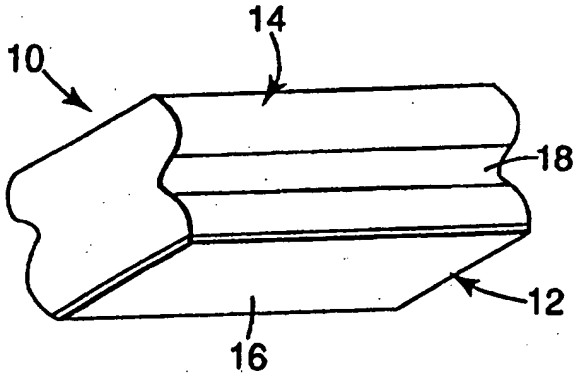
(57) Abstract

A cleaning article and a method for the manufacture of the article are described. The article comprises a cloth layer having a wiping surface thereon, the cloth layer comprising microfibers of polyester and nylon and a support adjacent the cloth layer. The cloth layer preferably is a knitted fabric made by a circular knitting process and the microfibers are provided in the cloth layer as distinct bundles. The cloth layer also comprises a ground yarn. The support for the article can comprise any of a variety of materials, depending on the contemplated end use for the finished article. Suitable materials for use as the support include sponges, foamed polymers, nonwoven webs and the like.



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CLEANING ARTICLE AND METHOD OF MAKING SAME

The present invention relates to a cleaning article having a cloth layer that provides a wiping surface and a support positioned adjacent to the cloth layer, to a kit comprising such a cleaning article and to a method of making such a cleaning article.

In the cleaning (e.g., dusting, wiping) of surfaces, a cleaning article is typically used in conjunction with an appropriate solvent or cleaning chemical. In light cleaning applications such as dusting, for example, the cleaning article can be a woven or nonwoven cloth, a paper product (e.g., paper towel) or even a sponge. Cleaning chemicals are often applied to the cleaning article or to the surface being cleaned in order to enhance the ability of the article to pick up the dust or dirt and at least temporarily retain it within the article. After one or more such uses, the article is either discarded or it may be cleaned and stored for future use.

Although surfaces retain soil from a variety of different sources, resulting in the deposition of grease, fingerprints, dust and other dirt, as well as water, common cleaning articles are generally not capable of effectively providing more than one type of cleaning effect. For example, an article that is suited for picking up one type of soil (e.g., dust), often is not well suited to pick up other types (e.g., coarse dirt particles). In cleaning soiled surfaces, available cleaning articles are generally unable to provide effective cleaning without the use of added cleaning chemicals. Surfaces soiled with fingerprints, oil and/or grease are typically cleaned with an article that has been rendered oleophilic. Similarly, water and water based soils are removed from a surface with an article that is hydrophilic. To achieve the needed degree of both hydrophilicity and oleophilicity, the cleaning article or the soiled surface is treated with one or more cleaning chemicals. The known art has failed to provide an effective cleaning article that is both oleophilic and hydrophilic in the absence of chemical treatment.

Likewise, in the field of personal care products, various articles are used in the course of normal hygiene. Some personal care articles are specially designed for specific applications, such as the removal of facial make-up, facial cleansing, and the

like. In these applications, the available articles generally are not designed for more than one specific personal care use.

Wiping or cleaning articles are known to the art, and some of these articles have been described in the patent literature.

U.S. Patent No. 3,414,928 to Lemelson describes an article comprised of a sponge with a scouring layer affixed to one side of the sponge. The scouring layer can be provided in any of a variety of forms including short monofilaments of rigid plastic, curled or shaped strips of plastic filaments, or curled wires of non-rusting metals such as copper or stainless steel.

U.S. Patent No. 4,001,472 to Thomas et al. describes a nonwoven cellulosic material useful as a wipe, toweling or disposable clothing. The material comprises cellulosic wadding affixed to a nonwoven scrim.

U.S. Patent No. 4,429,014 to Isner et al. describes a laminated wiper comprised of multiple layers of bonded fibers. The various layers of the described wipes are of differing densities. A dense support layer may be adhesively bonded to a less dense inner layer to reinforce the wiper.

U.S. Patent No. 4,940,631 to Colin et al. describes a cellular cellulosic material comprising a cellular cellulosic substrate covered on at least one side with an expanded latex foam. The article of the '631 patent is said to provide both absorbent and wiping functions and can be used to wipe a surface completely dry without having to use a second cellulosic product (e.g., paper or rag).

U.S. Patent No.5,178,932 to Perkins et al. describes a three layered antistatic nonwoven composite material with alcohol repellency.

U.S. Patent Nos. 5,186,751 and 5,281,272 to Moore describe laminated wipers for wire plating systems to remove excess plating material from wire. The wipers comprise a plurality of discrete layers of fibrous material. The outermost layer comprises a refractory fibrous material while the innermost layers may comprise a non- refractory fibrous material such as fiberglass.

U.S. Patent No. 5,429,854 to Currie et al. describes an apertured composite nonwoven web useful as a wipe, a floor mat or "otherwise".

U.S. Patent No. 5,397,625 to Osteen et al. describes a duo-functional nonwoven composite material useful in personal care products such as diapers. The material comprises a support layer and a layer comprising water soluble fibers affixed to the bottom surface of the support layer. The water soluble layer comprises water soluble fibers that extend through the support layer. As the top surface of the material is wetted, the water soluble fibers begin to dissolve, drawing the liquid away from the top surface of the material to maintain a dry feeling against the skin of the user.

In addition to the foregoing patents relating to cleaning articles, various processes for the preparation of fibers and knitted or woven fabrics have also been described in the patent literature.

Japanese Unexamined Patent Publication J.P. Hei 7-279037 describes a high stretch knitted cloth and a method for its manufacture wherein the cloth is prepared by the circular knitting technique. Wooly threads are combined with water soluble threads, the water soluble threads are then dissolved out of the knitted cloth and the knitted cloth is heat set. The resulting knitted cloth is characterized as ultra high stretch. The water soluble threads include polyvinyl alcohol and the wooly threads can include polyester and nylon.

Japanese Patent Sho 63-5509 describes a method for the manufacture of extremely fine polyvinyl alcohol fiber and a spinneret assembly for the manufacture of the fibers.

Japanese Patent Sho 63-42969 describes a manufacturing method and material. The manufacturing method is described as a weaving or knitting process that utilizes yarn that has low alkali solubility and a polyester yarn that is alkali soluble. The knitted or woven article is alkali treated to remove the polyester yarn protruding from the tips of the yarn tufts to provide a soft bulky fabric.

Japanese Unexamined Patent Publication J.P. Hei 2-68396 describes a binder fiber of polyvinyl alcohol that is water soluble at 50°C to 90°C. The described binder fiber finds utility in certain paper products used in flush toilets.

Japanese Unexamined Patent Publication J.P. Hei 8-3867 describes yarn comprised of polyvinyl alcohol and wool fiber. The bulkiness of the yarn is enhanced by an oxidation treatment.

The known art, as exemplified in the foregoing patents, has failed to provide a cleaning article with a wiping surface thereon that can be used to remove a variety of soils from any of a variety of surfaces. In particular, the art has failed to provide a multicomponent cleaning article that can be used without added cleaning chemicals in varied applications such as dusting, water pick-up, as well as the removal of oils, grease, fingerprints and the like. Similarly, the art has failed to provide multicomponent and multifunctional personal care articles capable of removing make-up or oils while also providing a facial rejuvenator, for example.

It is desirable, therefore, to fulfill a longfelt and unmet need to provide a composite article that can be used in the foregoing varied applications and which is preferably capable of providing different cleaning or wiping functions. In dusting applications, for example, it is desirable to provide an article that has at least one portion capable of picking up finer dust particles and at least one portion providing a means for grasping or holding the article and preferably also providing a second cleaning function such as picking up larger dirt particles, for example. Most preferably, it is desirable to provide an article capable of performing the foregoing cleaning applications without added chemicals. It is desirable to provide such a cleaning article in a variety of forms suited to particular cleaning applications such as dusting and wiping applications as well as personal care applications and the like. It is also desirable to provide a method for the manufacture of such an article.

The invention provides a cleaning article and a method for its manufacture. The article is suitable for use on any of a variety of surfaces. The article of the invention is capable of providing different cleaning functions with different portions of the article and the article can be used in numerous applications without added chemicals. In one application, the article is useful in the removal of dust, fingerprints, oil, grease, water and other dirt from surfaces. In another application, the article finds utility as a personal care product, particularly useful in the removal of facial make-up, for example. In still another application, the article of the

invention is useful as a sanitizing wipe that can be provided in conjunction with a kit. These various embodiments of the invention and their applications are described in more detail below.

In one aspect, the invention provides an article comprising:

A cloth layer comprising microfibers of polyester and nylon; and

a support adjacent the cloth layer.

The cloth layer preferably is a knitted fabric prepared by the circular knitting process. In the knitted article, the microfibers of nylon and polyester render the article oleophilic as well as hydrophilic. The microfibers in the cloth layer are present in bundles, each bundle typically comprising between about 10% and 90% by weight nylon and between about 90% and 10% by weight polyester, and preferably comprising about 70 wt% polyester and about 30 wt% nylon. The knitted article will preferably further comprise a ground yarn, most preferably polyethylene terephthalate yarn having a linear density typically within the range from 40 to 300 denier per yarn ("dpy"), and preferably about 150 dpy. The cloth layer is adjacent to the support and may be affixed to the support in any of a variety of ways. For example, the cloth layer may be adhesively affixed to the support, or the cloth layer may be wrapped around the support in a continuous loop of material that is dimensioned to retain the support within the loop of material without adhesives.

The support may be formed from any of a variety of materials capable of supporting the cloth layer and providing a means to grasp the article during a cleaning application (e.g., dusting). Included as possible support materials are lofty, three dimensional, nonwoven webs, foamed polymers such as foamed polyurethane, sponges and the like. In cleaning applications, the cloth layer and the support can perform separate cleaning functions, as described herein.

Certain terms used herein will be understood to have the following meanings. "Nonwoven" encompasses webs formed from staple fibers including air laid and carded webs, spun bonded and melt blown webs, as well as tows formed from continuous parallel-arranged filaments. "Wiping surface", means an exposed surface of a cloth layer positioned on a cleaning article for application to a surface.

"Hardening" means solidifying a coatable resin by drying or curing. "Linear density" or "fineness", in referring to yarns or to individual fibers, refers to the weight in grams of a 9,000 meter length of the fiber or yarn. "Fiber" or "filament" are used interchangeably to refer to a threadlike structure comprising the materials described herein. "Microfiber" refers to a fiber having a linear density of one (1) denier or less. "Greige cloth" refers to an unfinished cloth that, upon further processing, may be used as the cloth layer in the articles of the present invention. "Bundles" refers to a collection of microfibers resulting from the processing of microfiber containing yarns.

In another aspect, the invention provides a kit, comprising:

a cleaning article having a cloth layer and a support adjacent the cloth layer, the cloth layer comprising microfibers of polyester and nylon having a wiping surface thereon;

a container dimensioned to hold and store the cleaning article therein;

an absorbent substrate positioned within the container; and

a liquid composition absorbed on the absorbent substrate.

In this aspect of the invention, the cloth layer and the support layer are as described above. Preferably, the cloth layer is wrapped around the support in a continuous loop so that the cleaning article has at least two wiping surfaces thereon. In this construction, the container provides for storage of the article therein. The absorbent substrate may be a sponge or foamed polymer, for example, housed within the container and having the foregoing composition absorbed therein. The liquid composition may be any composition providing a cleaning, disinfecting, sanitizing or like function. The container is provided with a cover to releasably close and seal the container. In this arrangement, the cleaning article can be used as a sanitizing or a disinfecting wipe with a supply of sanitizing or disinfecting chemical stored within the absorbent material. The kit is preferably dimensioned to be portable to fit within a purse, brief case or the like. In this manner, the kit provides a portable means for sanitizing or disinfecting any of a variety of surfaces such as tables, counter tops, telephone receivers, and the like.

In still another aspect, the invention provides a method of making a cleaning article, comprising:

preparing a cloth layer comprising microfibers of polyester and nylon; and

positioning a support adjacent the cloth layer.

In this aspect of the invention, the support and the cloth layer are as described above. The step of preparing the cloth layer preferably comprises first knitting a greige cloth by a circular knitting method, the greige cloth formed with a pile yarn comprised of microfibers of polyester and nylon; a ground yarn, preferably a polyethylene terephthalate yarn; and a water soluble yarn, preferably comprising polyvinyl alcohol. Both the microfiber containing yarn and the water soluble yarn are used as pile yarns in the circular knitting process. After the knitting step is completed, the water soluble yarn is dissolved from the greige cloth by the application of hot water (e.g., greater than 60°C). The cloth is dried and may optionally be heat set. The thus prepared cloth layer may then be affixed to a suitable support by the use of adhesives or other attachment system.

The additional details of the invention will be more fully appreciated by those skilled in the art upon consideration of the remainder of the disclosure including the drawings, the detailed description of the preferred embodiment and the appended claims.

In describing the various aspects of the preferred embodiment, reference is made to the various Figures, wherein:

Figure 1 is a perspective view of a cleaning article constructed according to one embodiment of the invention;

Figure 2 is an exploded side elevation of the cleaning article of Figure 1;

Figure 3 is a perspective view of a cleaning article constructed according to a second embodiment of the invention;

Figure 4 is a perspective view of a cleaning article constructed according to a third embodiment of the invention; and

Figure 5 is an exploded perspective view of a kit utilizing the article of Figure 4 according to a fourth embodiment of the invention.

The details of the preferred embodiment will now be described with reference to the various Figures whenever appropriate, In describing the details of the preferred embodiment, various features thereof are identified using reference numerals wherein like reference numerals indicate like structures.

Referring to the Figures 1 and 2, a cleaning article 10 is shown to include a cloth layer 12 and a support 14. The support 14 provides a substantially flat first surface 20 to which the cloth layer 12 is affixed with a suitable adhesive material (not shown). Other attachment systems may also be used such as hook and loop, snaps and the like. When affixed to the support 14, the cloth layer 12 presents a wiping surface 16 along one major surface of the article 10.

The wiping surface 16 is positioned on the article 10 for direct application of the wiping surface 16 to a soiled surface such as a table top, a computer or television screen or the like. The wiping surface 16 is flat and rectangularly shaped but can also be circular, triangular or any other shape as needed to accommodate a particular cleaning application or as may otherwise be desired. The article 10 is particularly well suited for the cleaning of television or computer screens, windows, and the like.

The support 14 is preferably dimensioned to be comfortably gripped by the human hand. Preferably, the support 14 is formed from a resiliently deformable material so that a user of the article 10, by the application of adequate pressure, can deform the article 10 to engage the wiping surface 16 against the surface being cleaned. When that pressure is released, the material of the support 14 preferably will have sufficient memory to return the article 10 substantially to its original form. Preferably, the support 14 comprises a lightweight, resiliently flexible material such as a sponge material or a foamed polymeric material such as a polyurethane foam, for example. It will be appreciated that, in at least some applications, harder more rigid materials may be used as the support 14 for the cloth layer 12, and all such support materials are considered to be within the scope of the invention. As shown, the support 14 may be ergonomically shaped with longitudinally extending grooves 18 provided along two sides of the support 14. In use, the article 10 can be held in the hand by grasping the support 14 so that the user's fingers engage the article 10

within the grooves 18 while the palm of the hand extends over the second surface 22.

The cloth layer 12 includes bundles of microfibers which render the cloth layer 12 hydrophilic as well as oleophilic. Preferably, the microfibers comprise nylon and polyester microfibers provided as bundles in the finished cloth layer 12. As is discussed below with respect to the process for the manufacture of the cloth layer, the bundles are formed in the finished article 10 as a result of the processing of yarns made from fibers comprised of the microfibers. The preferred cloth layer 12 is a knitted fabric, either single knit or double knit, prepared by the circular knitting process and comprising the foregoing bundles of microfibers and a ground yarn.

The ground yarn in the cloth layer 12 provides support for the foregoing bundles of microfibers, and can comprise any of a variety of fibrous materials such as polyester (e.g., polyethylene terephthalate), nylon, rayon, cotton, and the like. Because of cost, commercial availability, and its ability to provide a cloth that is desirably soft, the ground yarn preferably comprises polyester fibers, most preferably polyethylene terephthalate (PET) fibers. The ground yarn may have a linear density between about 40 and 300 dpy, preferably about 150 dpy. Suitable commercially available polyester yarns include those available from DuPont of Wilmington, Delaware, comprising about 34 fibers per yarn with a linear density of about 150 dpy.

In adhering the cloth layer to the support, any of a variety of adhesive materials or fastening systems can be used. Suitable adhesive materials include the melt bondable adhesive web known under the trade designation "3M THERMOPLASTIC BONDING WEB 695", commercially available from Minnesota Mining and Manufacturing Company of St. Paul, Minnesota ("3M"). Another acceptable adhesive is that available under the trade designation, "JET WELD TS-115 HGS Thermoset Adhesive", a hot melt moisture curable urethane, also available from 3M. It will be appreciated that the invention is not limited to the particular type of adhesive used in the lamination of the cloth layer 12 to the support 14, and that it is within the skill of those practicing in the art to select a

particular adhesive material for this purpose. Moreover, attachment systems that present alternatives to adhesives are also contemplated, such as hook and loop systems, for example.

Referring to Figure 3, a second embodiment of a cleaning article 100 according to the invention is shown and will now be described. The article 100 includes a support 114 and a cloth layer 112 with a wiping surface 116. The support 114 is affixed to the cloth layer 112, as previously described. The cloth layer 112 and the wiping surface 116 are identical to the cloth layer 12 and the wiping surface 16, described above. The support 114 in the article 100 comprises a lofty, open nonwoven web of staple fibers. As those skilled in the art will appreciate, the specific characteristics and construction of the nonwoven support 114 can be varied depending on the intended end use of the finished article 100.

In general, nonwoven webs suitable for use as the support 114 in the articles of the invention may be made of an air-laid, carded, stitch-bonded, spunbonded, wet laid, or melt blown construction. An especially preferred nonwoven web is the open, lofty, three-dimensional air-laid nonwoven substrate described by Hoover et al. in U.S. Patent No. 2,958,593, incorporated herein by reference. The nonwoven web preferably comprises a first major web surface to which the cloth layer is affixed and a second major web surface 122 on the opposite side of the support 114. The web is made of a suitable synthetic fiber capable of withstanding the temperatures at which impregnating resins and adhesive binders are cured without deterioration.

Fibers suitable for use in the nonwoven support webs include natural and synthetic fibers, and mixtures thereof. Synthetic fibers are preferred including those made of polyester (e.g., polyethylene terephthalate), nylon (e.g., hexamethylene adipamide, polycaprolactum), polypropylene, acrylic (formed from a polymer of acrylonitrile), rayon, cellulose acetate, polyvinylidene chloride-vinyl chloride copolymers, vinyl chloride- acrylonitrile copolymers, and so forth. Suitable natural fibers include those of cotton, wool, jute, and hemp. The fiber material can be a homogenous fiber or a composite fiber, such as bicomponent fiber (e.g., a co-spun

sheath-core fiber). It is also within the scope of the invention to provide an article comprising different fibers in different portions of the web.

Where the nonwoven support web is of the type described by Hoover et al., identified above, fibers that are satisfactory in the formation of the web are typically between about 20 and about 110 millimeters and preferably between about 40 and about 65 millimeters in length and have a fineness or linear density typically ranging from about 1.5 to about 500 denier and preferably from about 1.5 to about 50 denier. It is contemplated that fibers of mixed denier can be used in the manufacture of a nonwoven support web for the articles of the invention. The use of larger fibers is also contemplated, and those skilled in the art will understand that the invention is not limited by the nature of the fibers employed or by their respective lengths, linear densities and the like.

The aforementioned nonwoven webs may be readily formed on a "Rando Webber" machine (commercially available from Rando Machine Company, New York) or may be formed by other conventional processes such as by carding, for example. Useful nonwoven webs typically have a weight per unit area of at least about 50 g/m^2, preferably between 50 and 1000 g/m^2, more preferably between 75 and 500 g/m^2. Lesser amounts of fiber within the nonwoven web will provide articles which may be suitable in some applications. The foregoing fiber weights will provide a web useful as a support and having a thickness typically from about 5 to about 200 millimeters, preferably between 6 to 75 millimeters, and more preferably between 10 and 30 millimeters.

The fibers of the web are preferably bonded to one another at their mutual contact points with a hardened resin (e.g., a prebond resin). However, the web may comprise melt bondable fibers wherein the fibers are bonded to one another by melted portions of the fibers, or by a combination of a hardened resin and melt bondable fibers, all as known by those skilled in the art. Where the fibers are bonded with a resin, the resin preferably comprises a coatable resinous adhesive such as a thermosetting water based phenolic resin, for example. Polyurethane resins may also be employed as well as other resins, and those skilled in the art will appreciate that the selection and amount of resin actually applied can depend on any

of a variety of factors including, for example, the fiber weight in the nonwoven web, the fiber density, the fiber type as well as the contemplated end use for the finished article. For phenolic prebond resins applied to a nonwoven web having a fiber weight within the above ranges, the prebond resin is applied to the web in a relatively light coating, typically providing a dry add-on weight within the broad range from about 50 to 500 g/m^2. The various types of resins are discussed in more detail below.

Articles such as the article 100 in this aspect of the invention are suitable in cleaning applications such as dusting and in personal care applications such as pads for the removal of facial make up and the like. When the article 100 is to be used as a cleaning article, the nonwoven web forming the support 114 is preferably comprised of the foregoing fibers and most preferably comprises polyester fibers having linear densities within the range from about 5 to about 50 denier. When the article is to be used as a personal care product, and especially where the article is to be applied to the user's face, the web used in the support preferably comprises fibers having a linear density less than about 10 denier.

It is contemplated that the articles of the invention may also be used in scouring applications wherein the nonwoven support 114 is provided with abrasive particles dispersed and adhered therewithin, and the cloth layer 112 provides a wiping function for the removal of grease, oil and water based soils from a soiled surface. In articles suitable for use in such scouring applications, abrasive particles are adhered to the surfaces of the fibers in the nonwoven support 114. The abrasive particles in the support 114 may include inorganic abrasive particles, organic based particles or combinations of inorganic abrasive particles and organic based particles.

Inorganic abrasives particles include hard inorganic abrasive particles (i.e., they have a Moh's hardness greater than 8) and soft inorganic abrasive particles (i.e., they have a Moh's hardness less than 8). Examples of conventional hard abrasive particles include fused aluminum oxide, heat treated aluminum oxide, white fused aluminum oxide, black silicon carbide, green silicon carbide, titanium diboride, boron carbide, tungsten carbide, titanium carbide, diamond, cubic boron

nitride, garnet, fused alumina zirconia, sol gel abrasive particles and the like. Examples of sol gel abrasive particles can be found in U.S. Patent Nos. 4,314,827, 4,623,364; 4,744,802, 4,770,671; 4,881,951, all incorporated herein after by reference.

Examples of conventional softer inorganic abrasive particles include silica, iron oxide, chromia, ceria, zirconia, titania, silicates and tin oxide. Still other examples of soft abrasive particles include metal carbonates (such as calcium carbonate (chalk, calcite, marl, travertine, marble and limestone), calcium magnesium carbonate, sodium carbonate, magnesium carbonate), silica (such as quartz, glass beads, glass bubbles and glass fibers) silicates (such as talc, clays, (montmorillonite) feldspar, mica, calcium silicate, calcium metasilicate, sodium aluminosilicate, sodium silicate) metal sulfates (such as calcium sulfate, barium sulfate, sodium sulfate, aluminum sodium sulfate, aluminum sulfate), gypsum, aluminum trihydrate, graphite, metal oxides (such as calcium oxide (lime), aluminum oxide, titanium dioxide) and metal sulfites (such as calcium sulfite), metal particles (tin, lead, copper and the like) and the like.

Organic based particles include plastic abrasive particles formed from a thermoplastic material such as polycarbonate, polyetherimide, polyester, polyethylene, polysulfone, polystyrene, acrylonitrile-butadiene-styrene block copolymer, polypropylene, acetal polymers, polyvinyl chloride, polyurethanes, nylon and combinations thereof. In general, preferred thermoplastic polymers of the invention are those having a high melting temperature or good heat resistance properties. The plastic abrasive particles can also be formed from crosslinked polymers. Examples of crosslinked polymers include: phenolic resins, aminoplast resins, urethane resins, epoxy resins, melamine-formaldehyde resins, acrylate resins, acrylated isocyanurate resins, urea-formaldehyde resins, isocyanurate resins, acrylated urethane resins, acrylated epoxy resins and mixtures of the foregoing materials and particles. These crosslinked polymers can be made, crushed and screened to the appropriate particle size and particle size distribution.

The abrasive particles are adhered to the fibers of the nonwoven support 114 by a hardened organic resin binder, typically the heat cured product of a

thermosetting coatable resinous adhesive applied to the fibers of the nonwoven support as a "binder precursor". As used herein, "binder precursor" refers to a coatable resinous adhesive material applied to the fibers of the nonwoven web to secure abrasive particles thereto. "Binder" refers to the layer of hardened resin over the fibers of the nonwoven web formed by hardening the binder precursor. The organic binders suitable for use as a binder precursor in the nonwoven support 114 are formed from an organic binder precursor, typically in a flowable state. During the manufacture of the nonwoven support 114, the binder precursor is converted to a hardened binder or make coat. The binder is typically in solid, non-flowable state. The binder can be formed from a thermoplastic material. Alternatively, the binder can be formed from a material that is capable of being crosslinked. It is also within the scope of this invention to have a mixture of a thermoplastic binder and a crosslinked binder. During the process to make the support 114, the binder precursor is typically mixed with the foregoing abrasive particles to form an adhesive/abrasive slurry that may be applied to the fibers of the nonwoven by any of a variety of known methods such as roll coating, knife coating, spray coating, and the like. The thus applied binder precursor is then exposed to the appropriate conditions to solidify the binder. For crosslinkable binder precursors, the binder precursor is exposed to the appropriate energy source to initiate polymerization or curing and to form the hardened binder.

The binder precursor is preferably an organic material that is capable of being crosslinked. The preferred binders precursors can be either a condensation curable resin or an addition polymerizable resin. The addition polymerizable resins can be ethylenically unsaturated monomers and/or oligomers. Examples of useable crosslinkable materials include phenolic resins, bismaleimide binders, vinyl ether resins, aminoplast resins having pendant alpha, beta unsaturated carbonyl groups, urethane resins, epoxy resins, acrylate resins, acrylated isocyanurate resins, urea-formaldehyde resins, isocyanurate resins, acrylated urethane resins, acrylated epoxy resins, or mixtures thereof.

The binder precursor suitable for use in the invention is a coatable, hardenable adhesive binder and may comprise one or more thermoplastic or,

preferably, thermosetting resinous adhesives. Resinous adhesives suitable for use in the present invention include phenolic resins, aminoplast resins having pendant α,β-unsaturated carbonyl groups, urethane resins, epoxy resins, ethylenically unsaturated resins, acrylated isocyanurate resins, urea-formaldehyde resins, isocyanurate resins, acrylated urethane resins, acrylated epoxy resins, bismaleimide resins, fluorene-modified epoxy resins, and combinations thereof. Catalysts and/or curing agents may be added to the binder precursor to initiate and/or accelerate the polymerization process.

Epoxy resins have an oxirane and are polymerized by the ring opening. Such epoxide resins include monomeric epoxy resins and polymeric epoxy reins. These resin can vary greatly in the nature of their backbones and substituent groups. For example, the backbone may be of any type normally associated with epoxy resins and substituent groups thereon can be any group free of an active hydrogen atom that is reactive with an oxirane ring at room temperature. Representative examples of acceptable substituent groups include halogens, ester groups, ether groups, sulfonate groups, siloxane groups, nitro groups and phosphate groups. Examples of some preferred epoxy resins include 2,2-bis[4-(2,3-epoxypropoxy)-phenyl)propane (diglycidyl ether of bisphenol a)] and commercially available materials under the trade designation "Epon 828", "Epon 1004" and "Epon 1001F" available from Shell Chemical Co., "DER-331", "DER-332" and "DER-334" available from Dow Chemical Co. Other suitable epoxy resins include glycidyl ethers of phenol formaldehyde novolac (e.g., "DEN-431" and "DEN-428" available from Dow Chemical Co.

Examples of ethylenically unsaturated binder precursors include aminoplast monomer or oligomer having pendant alpha, beta unsaturated carbonyl groups, ethylenically unsaturated monomers or oligomers, acrylated isocyanurate monomers, acrylated urethane oligomers, acrylated epoxy monomers or oligomers, ethylenically unsaturated monomers or diluents, acrylate dispersions or mixtures thereof.

The aminoplast binder precursors have at least one pendant alpha, beta-unsaturated carbonyl group per molecule or oligomer. These materials are

further described in U.S. Patent Nos. 4,903,440 (Larson et al.) and 5,236,472 (Kirk et al.), both incorporated herein by reference.

The ethylenically unsaturated monomers or oligomers may be monofunctional, difunctional, trifunctional or tetrafunctional or even higher functionality. The term acrylate includes both acrylates and methacrylates. Ethylenically unsaturated binder precursors include both monomeric and polymeric compounds that contain atoms of carbon, hydrogen and oxygen, and optionally, nitrogen and the halogens. Oxygen or nitrogen atoms or both are generally present in ether, ester, urethane, amide, and urea groups. Ethylenically unsaturated compounds preferably have a molecular weight of less than about 4,000 and are preferably esters made from the reaction of compounds containing aliphatic monohydroxy groups or aliphatic polyhydroxy groups and unsaturated carboxylic acids, such as acrylic acid, methacrylic acid, itaconic acid, crotonic acid, isocrotonic acid, maleic acid, and the like. Representative examples of ethylenically unsaturated monomers include methyl methacrylate, ethyl methacrylate, styrene, divinylbenzene, hydroxy ethyl acrylate, hydroxy ethyl methacrylate, hydroxy propyl acrylate, hydroxy propyl methacrylate, hydroxy butyl acrylate, hydroxy butyl methacrylate, vinyl toluene, ethylene glycol diacrylate, polyethylene glycol diacrylate, ethylene glycol dimethacrylate, hexanediol diacrylate, triethylene glycol diacrylate, trimethylolpropane triacrylate, glycerol triacrylate, pentaerthyitol triacrylate, pentaerythritol trimethacrylate, pentaerythritol tetraacrylate and pentaerythritol tetramethacrylate. Other ethylenically unsaturated resins include monoallyl, polyallyl, and polymethallyl esters and amides of carboxylic acids, such as diallyl phthalate, diallyl adipate, and N,N-diallyladipamide. Still other nitrogen containing compounds include tris(2-acryl-oxyethyl)isocyanurate, 1,3,5-tri(2-methyacryloxyethyl)-s-triazine, acrylamide, methylacrylamide, N-methyl-acrylamide, N,N-dimethylacrylamide, N-vinyl-pyrrolidone, and N-vinyl-piperidone.

Isocyanurate derivatives having at least one pendant acrylate group and isocyanate derivatives having at least one pendant acrylate group are further described in U.S. Patent No. 4,652,274 (Boettcher et al.), incorporated herein by

reference. The preferred isocyanurate material is a triacrylate of tris(hydroxy ethyl) isocyanurate.

Acrylated urethanes are diacrylate esters of hydroxy terminated isocyanate extended polyesters or polyethers. Examples of commercially available acrylated urethanes include "UVITHANE 782", available from Morton Chemical, and "CMD 6600", "CMD 8400", and "CMD 8805", available from UCB Radcure Specialties. Acrylated epoxies are diacrylate esters of epoxy resins, such as the diacrylate esters of bisphenol A epoxy resin. Examples of commercially available acrylated epoxies include "CMD 3500", "CMD 3600", and "CMD 3700", available from UCB Radcure Specialties.

Acrylated urethanes are diacrylate esters of hydroxy terminated NCO extended polyesters or polyethers. Examples commercially available acrylated urethanes include UVITHANE 782, available from Morton Thiokol Chemical, and CMD 6600, CMD 8400, and CMD 8805, available from Radcure Specialties.

Acrylated epoxies are diacrylate esters of epoxy resins, such as the diacrylate esters of bisphenol A epoxy resin. Examples of commercially available acrylated epoxies include CMD 3500, CMD 3600, and CMD 3700, available from Radcure Specialties.

Examples of ethylenically unsaturated diluents or monomers can be found in U.S. patent application serial no. 08/5,236,472 (Kirk et al.) and U.S. patent application serial no 08/144,199 (Larson et al.); the disclosures of both patent applications are incorporated herein by reference. In some instances these ethylenically unsaturated diluents are useful because they tend to be compatible with water.

Additional details concerning acrylate dispersions can be found in U.S. Patent No. 5,378,252 (Follensbee), incorporated herein by reference.

It is also within the scope of this invention to use a partially polymerized ethylenically unsaturated monomer in the binder precursor. For example, an acrylate monomer can be partially polymerized and incorporated into the binder precursor. The degree of partial polymerization should be controlled so that the resulting partially polymerized ethylenically unsaturated monomer does not have an

excessively high viscosity so that the binder precursor is a coatable material. An example of an acrylate monomer that can be partially polymerized is isooctyl acrylate. It is also within the scope of this invention to use a combination of a partially polymerized ethylenically unsaturated monomer with another ethylenically unsaturated monomer and/or a condensation curable binder.

In the manufacture of nonwoven webs for use as a support in the articles of the invention, the adhesive materials used as the binder precursor in the present invention preferably comprise thermosetting phenolic resins such as resole and novolac resins, described in Kirk-Othmer, *Encyclopedia of Chemical Technology*, 3d Ed. John Wiley & Sons, 1981, New York, Vol. 17, pp. 384-399, incorporated herein by reference. Resole phenolic resins are made with an alkaline catalyst and a molar excess of formaldehyde, typically having a molar ratio of formaldehyde to phenol between 1.0:1.0 and 3.0:1.0. Novolac resins are prepared under acid catalysis and with a molar ratio of formaldehyde to phenol less than 1.0:1.0. A typical resole resin useful in the manufacture of articles of the present invention contains between about 0.75% (by weight) and about 1.4% free formaldehyde; between about 6% and about 8% free phenol; about 78% solids with the remainder being water. The pH of such a resin is about 8.5 and the viscosity is between about 2400 and about 2800 centipoise. Commercially available phenolic resins suitable for use in the present invention include those known under the trade designations "Durez" and "Varcum", available from Occidental Chemicals Corporation (N. Tonawanda, N.Y.); "Resinox", available from Monsanto Corporation; and "Arofene" and "Arotap", both available from Ashland Chemical Company; as well as the resole precondensate available under the trade designation "BB077" from Neste Resins, a Division of Neste Canada, Inc., Mississauga, Ontario, Canada. Organic solvent may be added to the phenolic resin as needed or desired.

Commercially available nonwoven webs may be used as the support 114 in the articles 100. For example, articles which are to be used as a personal care product for the removal of make-up and the like, can be made with a nonwoven product available under the trade designation "BUF-PUF" from 3M. This particular nonwoven comprises 6 denier polyester fibers bonded at their mutual contact points

with a hardened urethane prebond resin. In articles to be used in scouring applications, a suitable commercially available nonwoven web is that available under the trade designation "SCOTCH-BRITE Green Scouring Pad", also available from 3M. This nonwoven web comprises 15 denier polyester fibers bonded at their mutual contact points with a hardened phenolic prebond resin and including aluminum oxide abrasive particles bonded to the fibers of the nonwoven with a hardened phenolic resin.

Referring now to Figure 4, a third embodiment of a cleaning article 200 according to the invention is shown and will now be described. The article 200 is similar to the article 100, described above, except that the article 200 includes a cloth layer 212 that extends around at least four sides of the support 214 in a continuous loop of material so that a continuous wiping surface 216 extends around the support 214. In this embodiment, the cloth layer 212 is as previously described, but different portions of the wiping surface 216 may be used for different purpose in a single application. For example, a portion of the wiping surface 216 may be used in the application of a sanitizing or disinfecting composition to a soiled surface, while another portion of the wiping surface 216 can then be used to remove the composition and dry the thus treated surface.

The support 214 may comprise any of a variety of materials including the materials described above in the discussion of the other embodiments, and the support 214 can be affixed to the cloth layer 212 by a frictional fit between the surface of the support and the continuous cloth layer 212. Alternatively, the cloth layer 212 can be adhesively affixed to the support 214, as previously discussed. It will be appreciated the support 214 in this embodiment of the invention serves mainly to support the cloth layer 212 and to provided the user with a portion of the article 200 that can be easily gripped in the hand. Consequently, the support 214 can comprise any material and construction that performs the foregoing function. Preferably, the support 214 is at least partially absorbent so that the article 200 can be used in cleaning wet surfaces or in sanitizing operations with the support serving to absorb moisture either from the surface being cleaned or from a source of sanitizing or disinfecting chemical, for example.

It will also be appreciated that the cloth layer 212 need not be provided in the form of the continuous loop of material described above. The cloth layer 212 can also be provided as two distinct cloth layers affixed (e.g., adhesively) to different surfaces of the support 214 so that the resulting article includes two separate cloth layers. Alternatively, the cloth layer 212 can be provided as a cloth envelope, completely enclosing the support 214 therein. Other such variations are also contemplated.

The article 200 may be used in conjunction with a kit 300, as shown in Figure 5. In this embodiment, the kit 300 includes a container having a main compartment 310 and a top or cover 320. The main compartment 310 is dimensioned to allow the storage of the article 200 therein. Additionally, the kit 300 includes a source of chemical such as a disinfecting solution, a sanitizing solution or the like. Preferably, the kit includes an absorbent bed, such as a sponge or foamed polymer, housed within the main compartment 310 and which includes the foregoing cleaning chemical absorbed therein. The cover 320 is dimensioned to fit over the opening of the main compartment 310 and provides a releasably closable seal to maintain the article 200, the absorbent bed and cleaning chemical within the kit 300, without spilling.

In this arrangement, the article 200 can be used as a sanitizing or a disinfecting wipe with a supply of sanitizing or disinfecting chemical stored within the absorbent material in the main compartment 310. The kit 300 is preferably dimensioned to be portable, and most preferably, the kit is dimensioned to fit within a purse, brief case or the like. The kit 300 provides a portable sanitizing or disinfecting wipe to clean any of a variety of surfaces such as tables, counter tops, telephone receivers, and the like. The kit can be used at home or when traveling such as in hotel rooms, restaurants or otherwise.

In the manufacture of the articles of the invention, the foregoing cloth layer is manufactured by first weaving a greige cloth, preferably by a circular knitting process. The greige cloth is produced by feeding continuous multifilament yarns into a circular knitting machine. Suitable knitting machines are commercially available such as those available from Monarch Company of Charlotte, North

Carolina or from Maier & Cie Company of Albstadt, Germany. In the manufacture of the preferred cloth layer for the articles of the invention, the greige cloth is made with at least two pile yarns and one ground yarn.

The pile yarns include the yarns comprised of the above mentioned polyester and nylon microfibers. In general, the greige cloth is preferably made from at least one yarn comprised of polyester and nylon microfibers. This microfiber containing yarn typically will have a linear density within the range from about 40 to about 300 denier, the yarn can be 1 or 2 ply and can comprise any number of filaments per yarn as may be processable in the circular knitting process. The microfiber containing yarn typically comprises between about 10 wt% and about 90 wt% nylon and between about 90 wt% and about 10 wt% polyester. One especially preferred yarn for use in the manufacture of the cloth layer is that known under the trade designation "WRAMP", available from Kuraray Co., Ltd. of Osaka, Japan. The "WRAMP" yarn has about 48 fibers per yarn, a linear density of about 150 dpy and comprises about 70 wt% polyester and about 30 wt% nylon. Another suitable commercially available microfiber containing yarn is that available under the trade designation "Belima X" from Kanebo Company, Japan.

Additionally, the greige cloth will include a water soluble pile yarn, such as yarns comprising polyvinyl alcohol ("PVA"), carboxy methyl cellulose thread, carboxy ethyl cellulose thread, alginate fiber, and combinations of the foregoing materials. Yarns comprised of PVA are preferred and suitable PVA pile yarns will have linear densities within the range from about 1 to 300 denier and typically will comprise any number of filaments per yarn as long as the yarn remains processable in the circular knitting process. Suitable commercially available PVA yarns include a PVA yarn available from Nichibi KK of Japan having a linear density of about 40 denier.

The ground yarn can comprise any of a variety of materials such as polyester (e.g., polyethylene terephthalate), nylon, rayon, cotton and the like as well as the foregoing nylon/polyester microfiber yarns. The ground yarn can have a linear density within the range from about 40 to about 300 denier and can comprise any number of filaments per yarn as may be processable in the circular knitting process.

One especially preferred ground yarn comprises polyethylene terephthalate ("PET") yarn having a linear density of about 150 with about 34 filaments per yarn. Such a yarn is commercially available from DuPont, Wilmington, Delaware.

Suitable greige cloths to be used in the formation of the articles of the invention will include from about 30 to about 70 wt%, preferably 40 to 60 wt%, of the foregoing nylon/polyester microfiber yarns, from about 3 to about 6 wt% of water soluble yarn (e.g., 40 denier PVA yarn), and from about 30 to about 60 wt%, preferably 35 to 55 wt%, of a suitable ground yarn (e.g., 150 denier PET yarn). A suitable basis weight for the greige cloth will typically be within the range from about 50 to about 400 g/m^2, preferably from about 175 to about 300 g/m^2. Other weight percentages of the foregoing yarns may also be used.

As those skilled in the knitting art will appreciate, the circular knitting process is performed with pile yarns and at least one ground yarn, as mentioned. In the articles of the invention the greige cloth for forming the cloth layer is formed with the foregoing yarns comprised of the polyester and nylon microfibers as the pile yarns and a ground yarn. The water soluble yarn is included in the formation of the greige cloth as a second pile yarn.

The circular knitting process may be performed using any suitable knitting machine for performing circular knitting. Commercially available knitting machines include those mentioned above. Preferably, the ground yarn and the microfiber containing yarn will have linear densities of about 150 dpy. The water soluble yarn will normally have a linear density that is less than those for the first yarn and second yarn. Typically, the water soluble yarn will have a linear density of about 40 dpy.

The yarns are fed through the thread feed entry to the circular knitting machine. The circular knitting machine knits the yarns to provide a tubularly shaped greige cloth which may be either a single knit or a double knit fabric having the proportions of the individual yarns, as described above. Preferably, the circular knitting of the greige cloth is performed using a three feeder knitting procedure. The needle hooks of the circular knitting machine are normally adjusted to accommodate the linear densities of the respective yarns. The circular knitting

process is performed in a known manner, resulting in the formation of the greige cloth comprising the foregoing weight percentages of the three yarns. The greige cloth is then further processed for use as a cloth layer in the articles of the invention.

It will be appreciated that the microfiber containing yarn is comprised of fibers wherein each such fiber is a collection of distinct nylon or polyester microfibers. The microfibers in the individual fibers of the yarn can be observed (e.g., microscopically) as alternating elongate layers or as wedge or pie shaped segments, for example, extending longitudinally along the lengths of the individual fibers. During the manufacture of the cloth layer, the foregoing fiber structure tends to delaminate or split so that the individual fiber structures, and the structures of the yarns originally made with those fibers, may no longer be observable within the cloth layer when observed under a microscope, for example. Instead of yarns or the original fibers, the individual microfibers may be seen arranged in distinct bundles woven into the cloth and supported by the ground yarns. The bundles appear as a collection of individual microfibers arranged side by side and appearing substantially parallel to and conterminous with one another.

Those skilled in the art will appreciate that the greige cloth can be prepared by other known knitting techniques as well as by weaving methods. All such methods for the preparation of the greige cloth are considered to be within the scope of the present invention. Knitting is generally preferred because the resulting cloth is more elastic than a woven cloth, providing a cloth layer that is easier to wring out when wet.

After the greige cloth is prepared, the cloth is then immersed in a hot water bath to dissolve and remove the water soluble yarn from the cloth. The temperature of the water bath will typically be greater than about 60°C, but the actual temperature of the water bath can be varied to accommodate the specific yarn being dissolved and to adjust process conditions as desired. As the soluble yarn dissolves, the cloth shrinks in both the warp and weft directions, while simultaneously expanding in thickness. During the dissolution of the water soluble yarn, dyes (e.g.,

azo dyes or anthroquinoid dyes) and/or antistatic agents can be applied to the cloth in a known manner.

Following washing, the tubular cloth is dried, typically at an elevated temperature in a flow through oven, to evaporate retained moisture. The tubular greige cloth is slit open for convenience of handling. To control shrinkage during the drying step, the cloth is stretched and placed in a tentering frame to hold the damp cloth while it is dried and to maintain the cloth at a preferred size or basis weight. Shrinkage control is optional but desirable because the cloth can otherwise experience shrinkage during the hot water wash of as much as 30%, resulting in an increase in the basis weight for the cloth by as much as 50% over the basis weight of the greige cloth prior to hot water washing. It should be appreciated that the actual dry weight of the cloth will decrease by about 5% due to the dissolution of the water soluble yarn.

After drying, a heat setting step may optionally be performed by retaining the cloth in the aforementioned tentering frame and further heating the cloth at temperatures within the range from about 121°C (250°F) to about 232°C (450°F), typically for about 30 seconds or more. The resulting cloth is then suitable for inclusion in an article of the invention by lamination to a support, for example.

Those skilled in the art will appreciate that the foregoing heat setting and hot water washing steps can be reversed to provide a cloth layer suitable for inclusion in the articles of the invention, and the invention is not to be construed as limited to any particular order for the performance of the foregoing process steps.

After the cloth layer has been thus prepared, it may be affixed to a suitable support. In the embodiments described above with respect to the articles 10 and 100, the supports 14 and 114 are laminated to the cloth layers 12 and 112, respectively, in a known manner using a suitable adhesive or other attachment system, as mentioned. In the article 300 of Figures 4 and 5, the cloth layer may be formed into a continuous loop of material by sewing two edges of the cloth together and then inserting the support into the thus formed loop. Preferably, the looped cloth layer 312 provides a suitably tight fit around the support 314 to hold the support within the cloth layer 312 without the need for adhesives or the like.

The thus finished article is ready for use in any of a variety of cleaning applications, as previously mentioned. It will be appreciated that the foregoing embodiments of the cleaning articles 10, 100 and 200 are merely illustrative of the articles within the scope of the invention. Changes to the described constructions are contemplated to be within the scope of the invention as long as the cleaning article is comprised of a cloth layer, as described, in combination with a support of some type. The support preferably will be functional by providing at least a portion that can be grasped by the human hand. Most preferably, the support will also comprise a material which enhances the cleaning abilities of the cloth layer.

TEST METHODS

In the Examples which follow, the following test methods were employed.

Test Procedure 1, Water Absorption

To determine the water absorbency of a cloth layer, a 150 mm x 200 mm sample is soaked in tepid water (approx. 20°C) for 15 minutes. The cloth is carefully transferred onto a weighing pan with one quick, smooth motion and the weight of the soaked cloth is recorded in grams (A). The soaked sample is then placed in a vented forced air oven at 50°C for at least 12 hours to fully dry the cloth. The weight of the fully dried cloth is taken and recorded in grams (B). The water absorbency of the cloth sample, defined as the grams of absorbed water per gram of the cloth layer, is calculated according to the following formula:

Absorbency = (A-B) / B

Test Procedure 2, Dust Pick-Up

To determine the ability of a cloth layer to pick up dust, a 150 mm x 200 mm samples of the cloth was first conditioned by heating the cloth at 50°C in an oven for approximately 2 hours. The cloth was then weighed and the weight in grams was recorded as the initial dry weight of the cloth (A). 100 mg of synthetic dust having the composition set forth in Table 1 was weighed out in a foil weighing pan and the cumulative weight of the dust and the pan were recorded as (B). The weighed dust was sprinkled evenly over the surface of a plastic sheet. Then the foil pan and remaining dust were again weighed and the cumulative weight of the pan and the remaining dust was subtracted from the above weight (B) to determine the

weight of the dust applied to the plastic surface, recorded as (C). A cloth layer prepared according to one of the Examples was used to hand wipe the plastic surface once to pick-up dust thereon. Care was taken to not to push the dust off the edge of the sheet. The cloth layer was then folded in half to entrap the dust, and the cloth layer (with the entrapped dust) was weighed and the weight of the cloth (A) was subtracted to obtain the weight of the dust from the first pick-up, recorded as (D). Without cleaning or shaking the cloth layer, the wiping process was repeated with the same cloth layer and the weight of the cloth (and entrapped dust) after the second pass was determined and the weight of the cloth (A) was subtracted to obtain the weight of the dust from the second pick-up, recorded as (E). The percent of the dust removed from the plastic surface after the first pass was determined according to the formula (I), below. The cumulative amount of dust picked up after the second pass was calculated according to the formula (II), below.

(I) % Dust Pick-up after first wiping = {D/ C} x 100

(II) Cumulative % Dust Pick-up after second wiping = {E/C} x 100

Table 1
(Synthetic Dust[1])

COMPONENT	WEIGHT PERCENT
walnut sawdust[2]	24.0%
pumice[3]	11.5%
60/80[4] A1203	6.0%
100/150[5] A1203	6.0%
flint[6]	22.5%
fullers earth[7]	23.0%
yellow pigment[8]	7.0%

1. Screened for particle size range of 125 microns or less.
2. Commercially available from Agrashell Company, Bath, PA under the designation "Grade AD-10.5M"
3. Commercially available under the trade designation, "Pumice 4F" from American Pumice Corporation, Santa Fe, NM
4. A blend of 60 grit (av. particle size of 336 microns) and 80 grit (av. particle size of 241 microns) aluminum oxide.
5. A blend of 100 grit (av. particle size of 169 microns), 120 grit (av. particle size of 133 microns) and 150 grit (av. particle size of 100 microns) aluminum oxide.
6. Commercially available under the trade designation "Silica 90 Sil-Co-Sil" from U.S. Silica Company, Ottawa, IL.
7. A porous colloidal aluminum silicate clay commercially available from Absorbent Clay Products, Mounds, IL under the trade designation "Cote-N-Flo".
8. Obtained from Columbia Chemical of Atlanta, GA under the trade designation "Iron Oxide Yellow".

Test Procedure 3, Removal of Fingerprints, Oils and Grease

A 70 mm X 150 mm cloth sample was wrapped around a 50 mm x 68 mm x 25 mm rectangular nonwoven web. The 60° gloss measurement of a cleaned glass surface was taken and recorded (the 60° gloss refers to the percentage of incoming light reflected from a surface at an observation angle of 60 degrees relative to the surface, as measured by a Byk Gardner Micro-TRI-Gloss meter). A plastic sheet was used to prepare a mask by cutting a 20 mm x 20 mm opening therein, and the mask was placed on the cleaned glass surface. With a cotton gauze, artificial sebum (to simulate fingerprints), Vegetable oil or grease were applied to the glass surface within the 20 mm x 20 mm opening in the plastic mask. A 60 degree gloss measurement of the contaminated area was taken and recorded.

The above mentioned pad comprising the cloth layer and the nonwoven web was positioned adjacent to the contaminated area, and the pad was connected to an electric drive, the speed of which was controlled by a potentiometer. A 1 kilogram weight was placed on the pad. The motor drive was preset to drag the pad across the contaminated area of the glass plate at a speed of 2.8 m / minute. The pad was positioned on one side of the soiled area so that the width of the pad would travel across the soiled area under the power of the motor. The pad was pulled over the contaminated surface 10 times, and a 60° gloss was recorded after the first, fifth and tenth passes.

PREPARATIVE PROCEDURES

The following procedures were used in the preparation of the articles described in the Examples.

Preparation of Cloth Layer

A double-knit greige web was prepared by feeding continuous multi-filament yarns into a 20 gauge and 30 inch- diameter circular knitter (from Monarch Company of Charlotte, North Carolina). The continuous filaments comprised three different yarns consisting of two pile yarns and a ground yarn. The first yarn, used as a pile yarn, was a multi-filament yarn containing 70 wt. % polyester and 30 wt. % nylon, 150 dpy, 48 filaments per yarn, purchased from Kuraray Company, Japan. The second yarn, used as the ground yarn, was a polyester (PET) yarn having a

linear density of 150 dpy and 34 filaments per yarn, purchased from DuPont of Wilmington, Delaware. The third yarn, a water soluble pile yarn, was a polyvinyl alcohol (PVA) yarn, 40 dpy, purchased from Nichibi Company, Japan.

The dry basis weight of the output greige cloth was measured then the cloth was dipped in a hot water bath at 95°C and agitated for 30 minutes to completely dissolve the PVA yarn. The resultant cloth was observed to have shrunk in both the warp and weft dimensions and to expand in thickness. The dry basis weight of the cloth after the hot water dissolution was measured.

Next, some of the thus prepared cloths were stretched in both weft and warp directions by about 30 % and then heat set in a flow through oven at 180°C for about 30 seconds. The dry basis weight of the thus prepared cloth layer was measured.

EXAMPLES

The following non-limiting Examples illustrate the preparation and the utility of the present invention. Unless otherwise indicated, all parts and percentages are by weight.

EXAMPLE 1

A knitted cloth layer was prepared according to the above preparative procedure except that the cloth was not heat set. The circularly knit greige cloth comprised 45 wt.% 1-ply polyester/nylon yarn, 50 wt. % PET yarn and 5 wt. % PVA yarn. The dry basis weight for the output greige cloth (e.g., immediately after knitting and before the hot water treatment) was 220 g/m^2. The dry basis weight of the cloth after the hot water dissolution, and after the cloth was allowed to dry, was 320 g/m^2.

EXAMPLE 2

A knitted cloth layer was prepared according to the above preparative procedure except that the cloth was not heat set. The circularly knit greige cloth comprised 57 wt.% 1-ply polyester/nylon yarn, 40 wt. % PET yarn and 3 wt. % PVA yarn. The dry basis weight for the output greige cloth (e.g., immediately after knitting and before the hot water treatment) was 240 g/m^2. The dry basis weight of the cloth after the hot water dissolution was 360 g/m^2.

EXAMPLE 3

A knitted cloth layer was prepared according to the above preparative procedure except that the cloth was not heat set. The circularly knit greige cloth comprised 44 wt.% 1-ply polyester/nylon yarn, 50 wt. % PET yarn and 6 wt. % PVA yarn. The dry basis weight for the output greige cloth (e.g., immediately after knitting and before the hot water treatment) was 240 g/m^2. The dry basis weight of the cloth after the hot water dissolution, and after the cloth was allowed to dry, was 300 g/m^2.

EXAMPLE 4

A knitted cloth layer was prepared according to the above preparative procedure except that the cloth was not heat set. The circularly knit greige cloth comprised 60 wt.% 1-ply polyester/nylon yarn, 36 wt. % PET yarn and 4 wt. % PVA yarn. The dry basis weight for the output greige cloth (e.g., immediately after knitting and before the hot water treatment) was 270 g/m^2. The dry basis weight of the cloth after the hot water dissolution, and after the cloth was allowed to dry, was 380 g/m^2.

EXAMPLE 5

A knitted cloth layer was prepared according to the above preparative procedure except that the cloth was not heat set. The circularly knit greige cloth comprised 40 wt.% 1-ply polyester/nylon yarn, 55 wt. % PET yarn and 5 wt. % PVA yarn. The dry basis weight for the output greige cloth (e.g., immediately after knitting and before the hot water treatment) was 200 g/m^2. The dry basis weight of the cloth after the hot water dissolution, and after the cloth was allowed to dry, was 270 g/m^2.

EXAMPLE 6

A knitted cloth layer was prepared according to the above preparative procedure. The circularly knit greige cloth comprised 60 wt.% 2-ply polyester/nylon yarn, 36 wt. % PET yarn and 4 wt. % PVA yarn. The dry basis weight for the output greige cloth (e.g., immediately after knitting and before the hot water treatment) was 250 g/m^2. The dry basis weight of the cloth after the hot

water dissolution, and after the cloth was allowed to dry, was 360 g/m^2. The dry basis weight of the cloth after heat set was 250 g/m^2.

EXAMPLE 7

A knitted cloth layer was prepared according to the above preparative procedure. The circularly knit greige cloth comprised 60 wt.% 2-ply polyester/nylon yarn, 35 wt. % PET yarn and 5 wt. % PVA yarn. The dry basis weight for the output greige cloth (e.g., immediately after knitting and before the hot water treatment) was 275 g/m^2. The dry basis weight of the cloth after the hot water dissolution, and after the cloth was allowed to dry, was 370 g/m^2. The dry basis weight of the cloth after heat set was 290 g/m^2.

The water absorbency for this cloth layer was determined according to the above Test Procedure 1. The water absorbency for this article was 6.7 grams of water absorbed per each gram of the cloth layer.

EXAMPLE 7 AND COMPARATIVE EXAMPLE A

Comparative testing was performed for the cloth layer of Example 7 and Comparative Example A. Comparative A was a disposable (e.g., paper) towel available commercially from Kimberly Clark Corporation (Roswell, GA) under the trade designation "Teri Towel", comprised of nylon reinforced wood pulp. All of the comparative testing was conducted without the use of any type of chemical cleaner.

Dust pick up was determined according to Test Procedure 2, above. The results are summarized in Table 2.

Table 2
Dust Pick Up

	% dust pick up (1st pass)	% dust pick up (2d pass)
Example 7	92 %	100 %
Comp. Ex. A	11 %	16 %

The comparative ability of the cloth layer of Example 7 and Comparative Example A to remove fingerprints and vegetable oil from a glass surface were tested according to Test Procedure 3, above. The 60° gloss data for the removal of artificial sebum, indicating the abilities of the tested articles to remove fingerprints,

are set forth in Table 3. The 60° gloss data for the removal of vegetable oil are set forth in Table 4.

Table 3
60° Gloss (artificial sebum[1])

	cleaned glass	contaminated glass	after 1st pass	after 5th pass	after 10th pass
Example 7	92.2	63.4	89.1	91.5	91.6
Comp. Ex. A	92.5	73.3	61.6	70.9	73.8

1. Prepared according to Spangler, *Synthetic Sebum*, J. Am. Oil Chem. Soc., Vol 42, p 723 (1965).

Table 4
60° Gloss (vegetable oil[1])

	cleaned glass	contaminated glass	after 1st pass	after 5th pass	after 10th pass
Example 7	92.0	70.1	84.3	90.5	90.4
Comp. Ex. A	92.0	69.0	27.1	29.8	41.7

1. Commercially available under the trade designation "Crisco".

The above test results demonstrate the clear superiority of the inventive cloth layer compared to the paper towel of the comparative example in all of the tested cleaning functions. The cloth layer of Example 7 showed an excellent ability to remove dust from a surface as well as fingerprints (represented by the data in Table 3) and oily substances (Table 4).

EXAMPLE 8

A 70 mm x 95 mm portion of a cloth layer, prepared according to Example 7, was laminated to a polyurethane foam (commercially obtained from Anespo Company of Barcelona, Spain) of the same surface area. The foam had a thickness of 40 mm, and the cloth layer was affixed to the foam by applying a hot melt adhesive ("Jet-Weld TS-115 HGS Thermoset Adhesive", obtained from 3M) to the foam surface and pressing the cloth layer onto the adhesive coated foam surface. The two longest sides of the polyurethane foam were cut to form longitudinal grooves, as described above.

EXAMPLE 9

A soft nonwoven web was prepared using a blend of 70 wt. % 15 denier polyester fiber and 30 wt. % 15 denier melty polyester fiber, both obtained from Hoechst-Celanese. The web was made using a Rando Webber machine (Rando

Machine Company, NY). The web was passed through a flow-through oven at 175°C to initiate bonding of the melty fiber to the composite web. The resultant web had a dry basis weight of 400 g/m^2 and a thickness of 25 mm.

A 76 mm x 102 mm portion was cut from the nonwoven web and then laminated to a 76 mm x 102 mm portion of a cloth layer prepared according to Example 7. The web and the cloth layer were laminated using a hot melt adhesive ("Jet-Weld TS-115 HGS Thermoset" adhesive from 3M).

EXAMPLE 10

An adhesive layer ("Thermoplastic Bonding Web 695" from 3M) was sandwiched between a cloth layer prepared according to Example 7 and a commercially available nonwoven scouring article ("Scotch-Brite Green Scouring Pad" from 3M). The resultant structure was then pressed together by applying a flat 700 gram metal plate over the cloth layer, and the support and cloth layer were placed in a flow through oven at 121°C for 2 minutes to melt the adhesive layer and initiate thermal curing. The resulting article was allowed to cool to room temperature.

EXAMPLE 11

An adhesive layer ("Thermoplastic Bonding Web 695" from 3M) was sandwiched between a cloth layer prepared according to Example 7 and a commercially available nonwoven product ("Buf-Puf Extra Soft Pad" from 3M). The resultant structure was then pressed together as in Example 10, and the article was placed in a flow through oven at 121°C for 2 minutes to melt the adhesive layer and initiate thermal curing. The resulting article was allowed to cool to room temperature.

EXAMPLE 12

A cloth layer prepared according to Example 7 was wrapped around a 75 mm x 120 mm x 35 mm block of polyurethane foam (commercially obtained from Anespo Company of Barcelona, Spain). The edges of the wiping cloth were then sewn together to form a continuous loop of material surrounding the foam support.

Although the preferred embodiment of the invention has been described in detail, it will be appreciated that various changes and modification can be made to

the described embodiments without departing from the spirit and scope of the invention, as set forth in the appended claims.

We claim:

1. A cleaning article comprising:

A cloth layer having a wiping surface thereon, the cloth layer comprising microfibers of polyester and nylon; and

a support for the cloth layer.

2. The cleaning article as defined in claim 1 wherein the microfibers are arranged in bundles and wherein the cloth layer is knitted.

3. The cleaning article as defined in claim 2 wherein each bundle comprises between about 10% and 90% by weight nylon and between about 90% and 10% by weight polyester.

4. The cleaning article as defined in claim 2 further comprising a polyester terephthalate ground yarn having a linear density within the range from 40 to 300 denier.

5. The cleaning article as defined in claim 1 wherein the cloth layer is adhesively affixed to the support.

6. The cleaning article as defined in claim 1 wherein the cloth layer is wrapped around the support in a continuous loop of material.

7. The cleaning article as defined in claim 1 wherein the support comprises a lofty, three dimensional, nonwoven web of fibers, the fibers bonded to one another at points of mutual contact.

8. The cleaning article as defined in claim 7 wherein the fibers are bonded to one another with a hardened resin selected from the group consisting of phenolic resins, aminoplast resins having pendant α,β- unsaturated carbonyl groups, urethane resins, epoxy resins, ethylenically unsaturated resins, acrylated isocyanurate resins,

urea-formaldehyde resins, isocyanurate resins, acrylated urethane resins, acrylated epoxy resins, bismaleimide resins, fluorene-modified epoxy resins, and combinations thereof.

9. The cleaning article as defined in claim 1 wherein the lofty, three dimensional, nonwoven web of fibers comprises abrasive particle adhered to the fibers.

10. The cleaning article as defined in claim 1 wherein the support comprises foamed polyurethane.

11. The cleaning article as defined in claim 1 wherein the support comprises a sponge.

12. A cleaning article comprising:

A knitted cloth layer having a wiping surface thereon, the cloth layer comprising bundles of polyester microfibers and nylon microfibers and a polyethylene terephthalate ground yarn; and

a support affixed to the cloth layer.

13. The cleaning article as defined in claim 12 wherein each bundle comprises between about 10% and 90% by weight nylon and between about 90% and 10% by weight polyester.

14. The cleaning article as defined in claim 12 wherein the ground yarn has a linear density of about 150 denier.

15. The cleaning article as defined in claim 12 wherein the support comprises a lofty, three dimensional, nonwoven web of fibers, the fibers bonded to one another at points of mutual contact.

16. The cleaning article as defined in claim 12 wherein the lofty, three dimensional, nonwoven web of fibers comprises abrasive particle adhered to the fibers.

17. The cleaning article as defined in claim 12 wherein the support comprises foamed polyurethane.

18. The cleaning article as defined in claim 12 wherein the support comprises a sponge.

19. A cleaning article comprising:

A knitted cloth layer having a wiping surface thereon, the cloth layer comprising bundles of polyester microfibers and nylon microfibers and polyethylene terephthalate ground yarns; and

a support for the cloth layer, the cloth layer extending around the support.

20. The cleaning article as defined in claim 19 wherein each bundle comprises between about 10% and 90% by weight nylon and between about 90% and 10% by weight polyester.

21. The cleaning article as defined in claim 19 wherein the ground yarn has a linear density of about 150 denier.

22. The cleaning article as defined in claim 19 wherein the support comprises a lofty, three dimensional, nonwoven web of fibers, the fibers bonded to one another at points of mutual contact.

23. The cleaning article as defined in claim 22 wherein the lofty, three dimensional, nonwoven web of fibers comprises abrasive particle adhered to the fibers.

24. The cleaning article as defined in claim 19 wherein the support comprises a foamed polyurethane article.

25. The cleaning article as defined in claim 19 wherein the support comprises a sponge.

26. A kit, comprising:

a cleaning article having a cloth layer and a support for the cloth layer, the cloth layer comprising microfibers of polyester and nylon and having a wiping surface thereon;

a container dimensioned to hold and store the cleaning article therein;

an absorbent substrate positioned within the container; and

a liquid cleaning composition absorbed on the absorbent substrate.

27. The cleaning article as defined in claim 26 wherein the microfibers are arranged in bundles and wherein the cloth layer is knitted.

28. The kit as defined in claim 27 wherein each bundle comprises between about 10% and 90% by weight nylon and between about 90% and 10% by weight polyester.

29. The kit as defined in claim 27 further comprising ground fibers comprising polyester terephthalate having a linear density within the range from 40 to 300 denier.

30. The kit as defined in claim 26 wherein the cloth layer is adhered to the support.

31. The kit as defined in claim 26 wherein the cloth layer is wrapped around the support in a continuous loop.

32. The kit as defined in claim 26 wherein the support comprises a lofty, three dimensional, nonwoven web of fibers, the fibers bonded to one another at points of mutual contact.

33. The kit as defined in claim 32 wherein the lofty, three dimensional, nonwoven web of fibers comprises abrasive particle adhered to the fibers.

34. The kit as defined in claim 26 wherein the support comprises foamed polyurethane.

35. The kit as defined in claim 26 wherein the support comprises a sponge.

36. A method for the manufacture of a cleaning article, comprising:
preparing a cloth layer comprising microfibers of polyester and nylon; and
positioning a support for the cloth layer.

37. The method as defined in claim 36 wherein the preparing comprises:
knitting a greige cloth with a pile yarn comprised of microfibers of polyester and nylon, a ground yarn; and a water soluble yarn;
dissolving the water soluble yarn from the greige cloth by the application of water thereto;
drying the cloth after the water soluble yarns are dissolved; and
optionally, heat setting the cloth.

38. The method as defined in claim 37 wherein the knitting is accomplished by circular knitting.

39. The method as defined in claim 37 wherein the pile yarn comprised of microfibers of polyester and nylon has a linear density within the range from 40 to 300 denier.

40. The method as defined in claim 37 wherein the pile yarn comprised of microfibers of polyester and nylon comprises between about 10% and 90% by weight nylon and between about 90% and 10% by weight polyester.

41. The method as defined in claim 37 wherein the ground yarn comprises polyester terephthalate having a linear density within the range from 40 to 300 denier.

42. The method as defined in claim 36 wherein the positioning of the cloth layer is accomplished by applying an adhesive to the support and affixing the cloth layer and the support to one another.

43. The method as defined in claim 36 wherein the positioning of the cloth layer is accomplished by applying an adhesive to the cloth layer and affixing the cloth layer and the support to one another.

44. The method as defined in claim 36 wherein the positioning of the cloth layer is accomplished by wrapping the cloth layer around the support.

45. The method as defined in claim 36 wherein the support comprises a lofty, three dimensional, nonwoven web of fibers, the fibers bonded to one another at points of mutual contact.

46. The method as defined in claim 45 wherein the lofty, three dimensional, nonwoven web of fibers comprises abrasive particle adhered to the fibers.

47. The method as defined in claim 36 wherein the support comprises foamed polyurethane.

48. The method as defined in claim 36 wherein the support comprises a sponge.

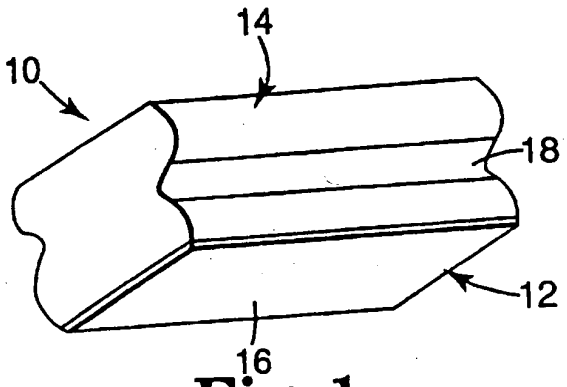

Fig. 1

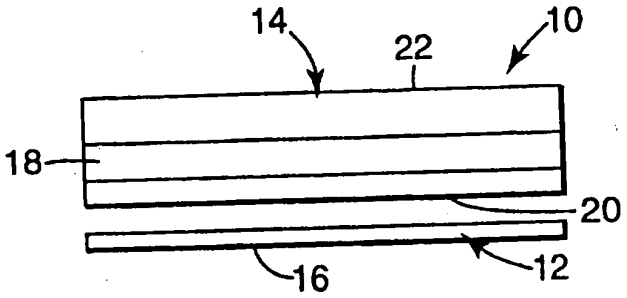

Fig. 2

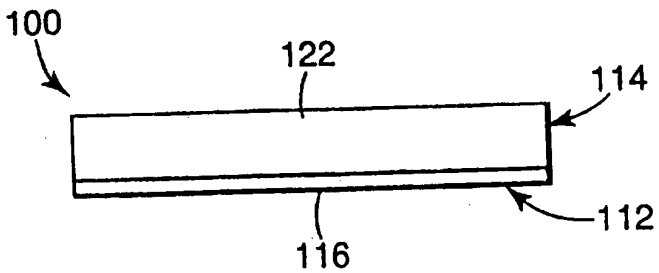

Fig. 3

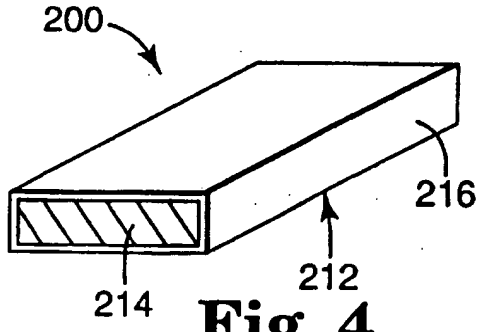

Fig. 4

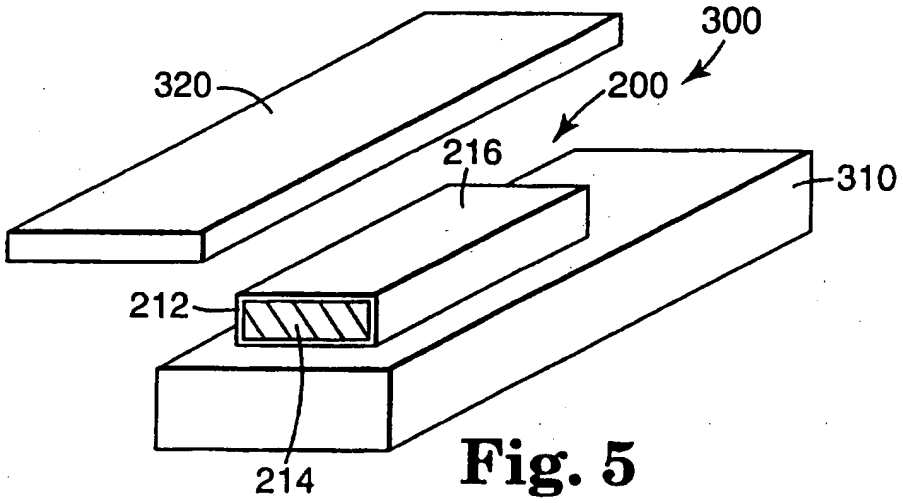

Fig. 5

INTERNATIONAL SEARCH REPORT

Int ional Application No
PCT/US 96/17350

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A47L13/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 3 616 149 A (WINCKLHOFER ROBERT C ET AL) 26 October 1971 see column 2, line 5-51 see column 9, line 14-24 see claims 1,5,8,13,14	2-4, 12-14, 17-21, 25,27-29

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
4 March 1997	10.04.97

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

In ional Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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